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A Case Study

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Micronutrient status in soils of Shirpur tehsil of Dhule district (M.S.) India

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Summary

Soil survey was carried out during 2014 in Shirpur tehsil of Dhule district (M.S.), India by using global positioning system (GPS) and geographical information system (GIS). Soil samples were analyzed for pH, EC, OC, $CaCO_3$ and available micronutrients *viz.*, Fe, Mn, Zn, Cu, B and Mo. The availability of macronutrients, micronutrients and their relationship with soil properties were also studied. The soil pH varied from 6.7 to 8.4 with mean value of 7.6 and indicated that slightly to moderately alkaline in reaction. The soil EC varied from 0.10 to 0.82 dSm^{-1} (mean 0.28 dSm^{-1}) and indicated that 100 per cent soils are non-saline in nature. The organic carbon and calcium carbonate ranged from 3.9 to 8.2 g kg^{-1} and 7.0 to 17.75 per cent with mean value of 6.12 g kg^{-1} and 12.28 per cent, respectively. The soils of Shirpur tehsil are low to high in organic carbon and high to very high in calcium carbonate content. The available micronutrients Fe, Mn, Zn, Cu, B and Mo ranged from 1.19 to 14.8, 2.02 to 5.88, 0.13 to 1.58, 0.27 to 3.98, 0.16 to 1.48 and 0.06 to 0.39 mg kg^{-1} with mean of 4.09, 2.78, 0.71, 2.32, 0.61 and 0.18 mg kg^{-1}, respectively. The soils of Shirpur tehsil were deficient in available iron (49.76%), available zinc (33.82%) and available boron (27.05%). The available Fe, Mn, Zn, Cu and B showed negative significant correlation and available Mo showed positive significant correlation with pH. Available Mn and Cu showed positive significant correlation with organic carbon. A negative significant correlation of available Cu with calcium carbonate was observed.

Key words : Micronutrients, Global positioning system (GPS) Geographical information system (GIS)

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Introduction

The global positioning system (GPS) and geographic information system (GIS) are advanced tool for studying on site specific nutrient management which can be efficiently used for monitoring soil fertilization in Shirpur tehsil of Dhule district (M.S.) and would be useful for ensuring balanced fertilization to crops. Investigation of nutrients status in soils mostly carried out to explain crop failures and to determine the effect on plant growth of elements, other than those already recognized as essential. Micronutrients are important for maintaining soil health and also increasing productivity of crops. The deficiency or the excess presence of the micronutrients such as Fe, Mn, Zn and Cu may produce synergetic and antagonistic effects in plants. This caused declined in productivity of crops. Nutrients strength and their relationship with soil properties affect the soil health.

The present study was taken upto assess the available micronutrients status of Shirpur tehsil for Fe, Mn, Zn, Cu, B and Mo by using global positioning system (GPS) and to develop maps of Shirpur tehsil based on nutrient status by using geographical information system (GIS).

Resource and Research Methods

The study area Shirpur tehsil covers an area of 1106 sq km. It lies between 19^0 2' to 22^0 03' North latitude, 74^0 10' to 75^0 11' East longitude. Shirpur tehsil is situated in Khandesh region of Maharashtra state. It is northern most tehsil of Dhule district, bordering with Madhaya Pradesh state to its north. Shirpur tehsil is located in Tapi basin. Tapi river flows westwards in the south part of tehsil and receives tributaries from north mainly Aner, Arunawati, Kordi, Nandi etc. Tapi river deposits alluvial soil along with its borders. The climate of tehsil is whole dry except during south west monsoon season. Shirpur tehsil falls under assured rainfall zone with 700 to 900 mm rainfall and 75 per cent rainfall received in the tehsil which is useful for *Kharif* crops.

The processed soil samples were analyzed for the basic soil parameters *viz.*, pH, EC, OC and $CaCO_3$. Available micronutrients *viz.*, Fe, Mn, Zn, Cu, B and Mo by using standard analytical methods.

Research Findings and Discussion

The range and mean values of analyzed soil samples are given in Table 1 and 2. The soil pH of Shirpur tehsil of Dhule district ranged from 6.72 to 8.48 with an average of 7.66 (Table 1). Most of the soil samples were slightly alkaline in soil reaction (Fig. 1). Similar results were reported by Kadu (2007). The pH is higher due to increase in accumulation of exchangeable sodium and calcium carbonate. In semi-arid regions, since rainfall is less as compared to annual evapo-transpiration, less

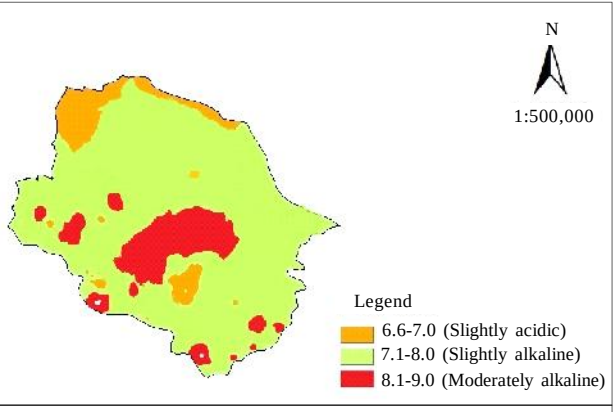

Fig. 1 : pH status of Shirpur tehsil

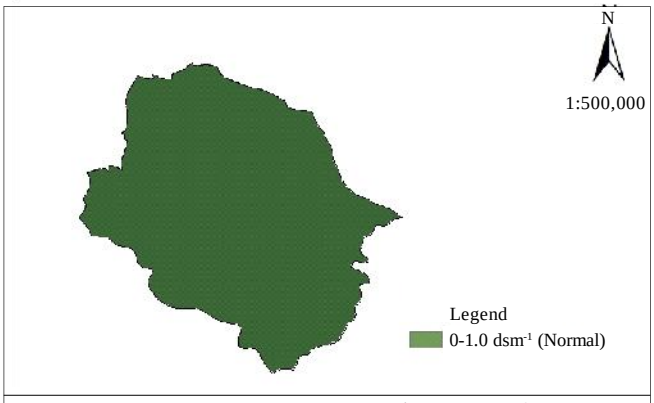

Fig. 2 : Electrical conductivity (dsm^{-1}) in soils of Shirpur tehsil

Table 1 : Soil properties and available N, P and K status in soil of Shirpur tehsil

Sr. No.	Parameter	Range	Mean
1.	pH	6.72 – 8.48	7.66
2.	Electrical conductivity (dSm^{-1})	0.10 – 0.82	0.28
3.	Organic carbon (g kg^{-1})	3.9 – 8.2	6.12
4.	Calcium carbonate (%)	7.0 – 17.75	12.28

Table 2 : Available micronutrient (mg kg^{-1}) status in soils of Shirpur tehsil

Sr. No.	Available micronutrient	Critical limit	Range	Mean	Sufficient (%)	Deficient (%)
1.	Iron	4.5	1.19-14.8	4.09	50.24	49.76
2.	Manganese	2.0	2.02-5.88	2.78	100	Nil
3.	Zinc	0.6	0.13-1.58	0.71	66.18	33.82
4.	Copper	0.2	0.27-3.98	2.32	100	Nil
5.	Boron	0.5	0.16-1.48	0.61	72.95	27.05
6.	Molybdenum	0.05	0.06-0.39	0.18	100	Nil

chances is available for the leaching of insoluble carbonates and bicarbonates of the calcium. The EC of soils of Shirpur tehsil of Dhule district ranged from 0.10 to 0.82 dSm^{-1} with the mean value 0.28 dSm^{-1} (Table 1). The EC of soils under investigation fall under normal category (Fig. 2). Similar results were reported by Waikar *et al*. (2004). It may be due to formation of these soils from basaltic parent material rich in basic cations.

The organic carbon content in soils of Shirpur tehsil of Dhule district ranged from 3.9 to 8.2 g kg^{-1} the mean value 6.12 g kg^{-1} (Table 1). Most of the soil samples were moderate to moderately high category in organic carbon content (Fig. 3). The similar findings were reported by Chaudhari and Kadu (2007). The moderate organic carbon content might be due to high temperature prevailing during the summer under the semi-arid climate of Shirpur tehsil which favours for high rate of decomposition of organic matter. The range of $CaCO_3$ in soils 7 to 17.75 per cent with an average of 12.28 per cent (Table 1). The similar results were found by Dhage *et al*. (2000). The soils of the Shirpur tehsil region were highly calcareous in nature (Fig. 4) due to hard water, river water or ground water used in irrigation contains salt. In the absence of sufficient natural drainage as in waterlogged soils and without a proper leaching and drainage to remove salts, this would lead to high soil salinity and reduce crop yields in the long run.

The available iron in soils of Shirpur tehsil of Dhule district (M.S.) was rambled from 1.19 to 14.8 mg kg^{-1} with an average of 4.09 mg kg^{-1} (Table 2). The available iron in soils of Shirpur tehsil were under very low to moderately high category (Fig. 5). Out of all 49.76 per cent samples were deficient and 50.24 per cent were sufficient in available iron. The result indicated that soils were deficient in an iron, it might be due to unavailability of iron under alkaline condition. The availability of iron is due to slightly acidic condition and organic matter content in soil. The similar trend of Fe was reported by Nagendran and Angayarkanni (2010) in soils of cumbum valley, Tamil Nadu. The available manganese in soils of Shirpur tehsil varied from 2.02 to 5.88 mg kg^{-1} with mean value 2.78 mg kg^{-1} (Table 2). Available manganese was

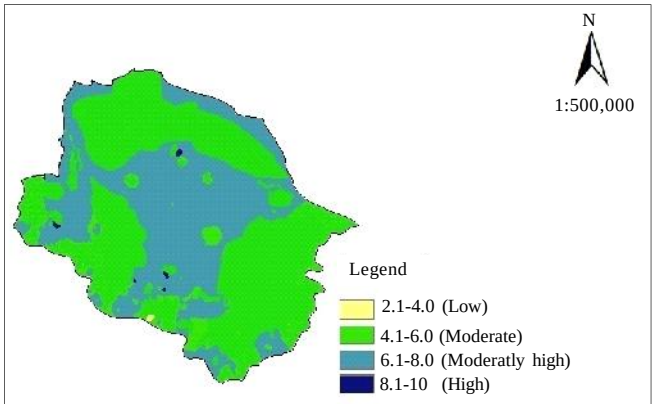

Fig. 3 : Organic carbon (g kg^{-1}) in soils of Shirpur tehsil

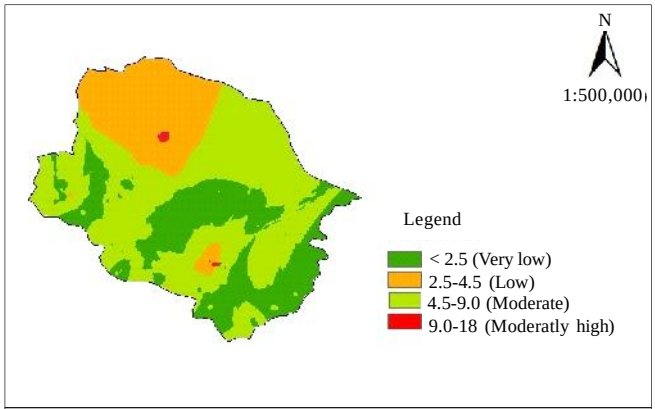

Fig. 5 : Available iron (mg kg^{-1}) in soils of Shirpur tehsil

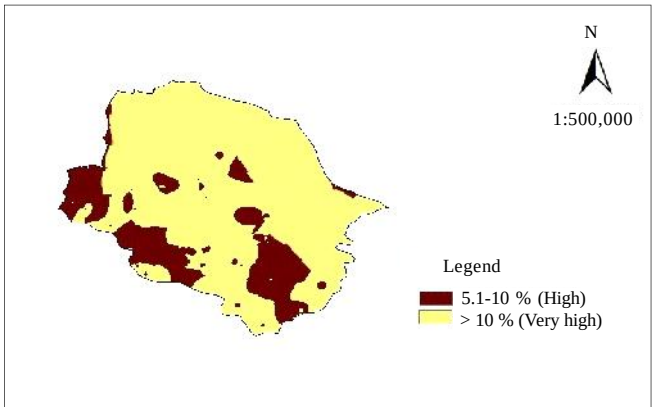

Fig. 4 : Calcium carbonate (%) in soils of Shirpur tehsil

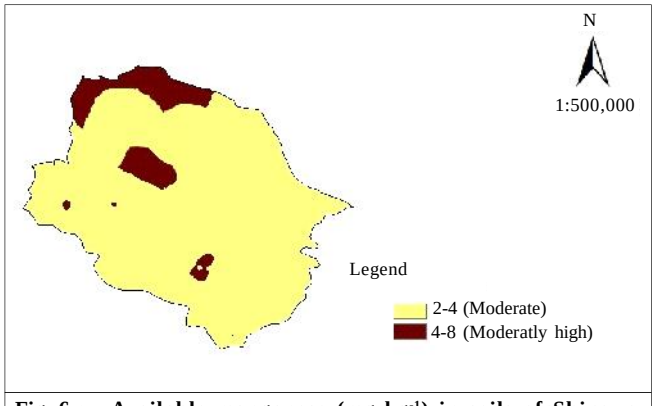

Fig. 6 : Available manganese (mg kg^{-1}) in soils of Shirpur tehsil

fall under moderate to moderately high category in soils of Shirpur tehsil (Fig. 6). All the samples were sufficient in available manganese. The sufficiency of available manganese might be due to high organic matter content under optimum soil reaction. Also the sufficient content of NPK is responsible for availability of manganese in soil. The similar results were supported by Hundal *et al.* (2006).

The available zinc in soils of Shirpur tehsil of Dhule district ranged from 0.13 to 1.58 mg kg^{-1} with an average of 0.71 mg kg^{-1} (Table 2). The available zinc in soils of Shirpur tehsil were under very low to moderately high category (Fig 7). The results showed that the 33.82 per cent samples were deficient and 66.18 per cent were sufficient in available zinc. The similar results were reported by Katkar and Patil (2010) in soils of Vidarbha region of Maharashtra. The deficiency in available Zn might be due to alkaline soil reaction and low organic matter content in soil, which acts as natural chelating agent, The sufficiency of Zn is due to slightly acidic pH and moderate to high OC. Available copper in soils of Shirpur tehsil ranged between 0.27 to 3.98 mg kg^{-1} with average value of 2.32 mg kg^{-1} (Table 2). The soil samples fall under moderate to very high in copper content (Fig. 8). The data indicated that all the samples were sufficient in available copper. Similar results were observed by Pulakeshi *et al.* (2012) in soils of Mantagani village in north Karnataka. The sufficiency of available copper in soils of Shirpur tehsil might be due to interactive effect of soil properties like pH, EC and OC which have managing role in availability of Cu.

The available boron in soils ranged from 0.16 to 1.48 mg kg^{-1} with an average of 0.61 mg kg^{-1} (Table 2). The available boron is categorized as very low to high in soils of Shirpur tehsil (Fig. 9). Out of all the soil samples collected, 27.05 per cent samples were deficient and 72.95 were sufficient in available boron. The data indicate that the majority of soils found sufficient in available boron might be due to increased level of soil organic matter and slight deficiency might be due to unavailability of boron in alkaline pH of soil. Similar results were recorded by Arora and Chahal (2014) in alkaline alluvial soils of Punjab. Available molybdenum in soils of Shirpur tehsil varied from 0.06 to 0.39 mg kg^{-1} with mean value 0.18 mg kg^{-1} (Table 2). The majority of soil under moderate to moderately high category of available molybdenum (Fig. 10). All the soil samples collected from Shirpur tehsil are sufficient in available molybdenum. The sufficiency of molybdenum might be due to higher amount of bases like

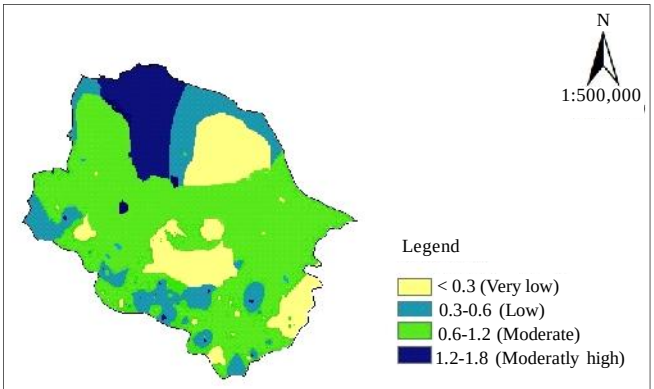

Fig. 7 : Available zinc (mg kg^{-1}) in soils of Shirpur tehsil

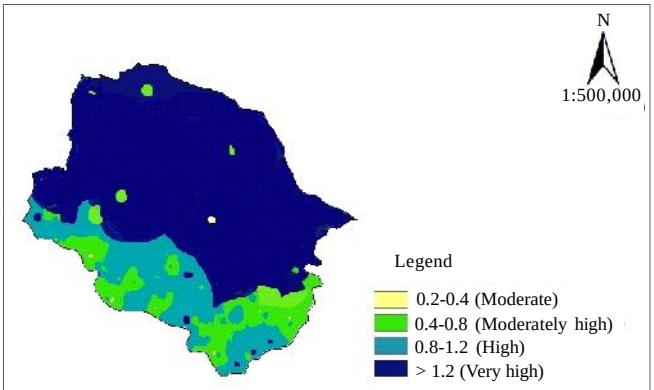

Fig. 8 : Available copper (mg kg^{-1}) in soils of Shirpur tehsil

Table 3 : Correlation of available micronutrients with soil properties

Available micronutrient	Chemical properties			
	pH	EC	O.C.	$CaCO_3$
Fe	-0.7507**	0.0670	0.1316	0.0075
Mn	-0.7086**	0.1297	0.1442*	-0.0250
Zn	-0.8573**	0.0590	0.0842	0.0331
Cu	-0.5533**	0.1137	0.6554**	-0.2429**
B	-0.8823**	0.0678	0.0308	0.0500
Mo	0.8309**	0.0507	0.0009	-0.0427

Number of samples- 207, * and ** indicate significance of values at P=0.05 and 0.01, respectively

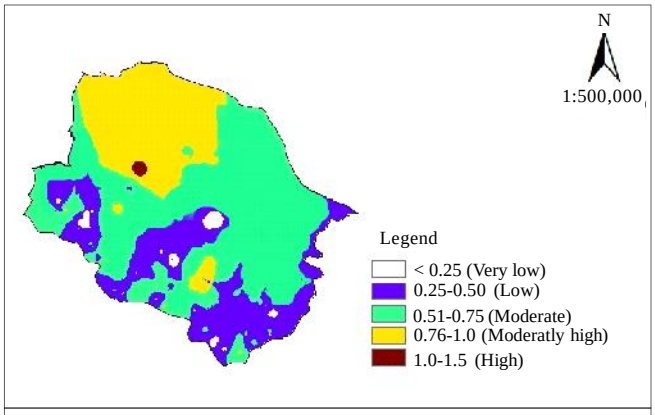

Fig. 9 : Available boron (mg kg^{-1}) in soils of Shirpur tehsil

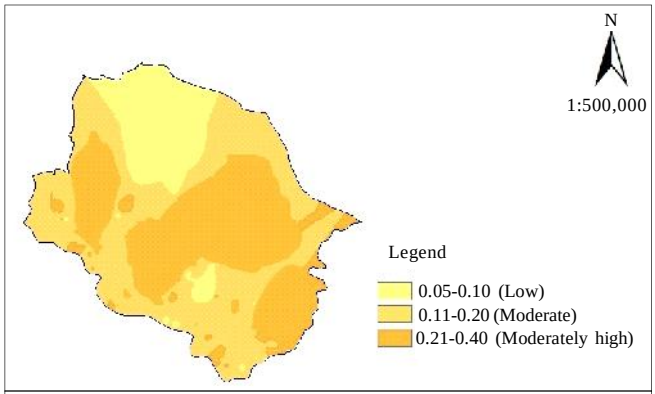

Fig. 10 : Available molybdenum (mg kg^{-1}) in soils of Shirpur tehsil

Ca and Mg and alkaline pH at observed sites. This is because of increase in Mo availability with increase in pH due to replacement of MoO_4^{2-} by OH^- ions and moderate to high OC. The results of present investigation are in close proximity with the findings of Medhe *et al.* (2012).

Conclusion :

The area of Shirpur tehsil of Dhule district was slightly acidic to moderately alkaline in soil reaction and normal in salt content. The soils were low to high in organic carbon and high to very high in calcium carbonate content. In case of micronutrients, 49.76 per cent samples were deficient and 50.24 per cent samples were sufficient in available iron. Total 33.82 per cent soil samples were deficient and 66.18 per cent soil samples were sufficient in available zinc. The available boron, 27.05 per cent samples showed deficiency and 72.95 per cent samples were sufficient. Similarly the soils of Shirpur tehsil were sufficient in available Mn, Cu and Mo.

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